
जलमिति — निलंबित तलछट
सैम्पलरों की कार्यकारिता अपेक्षाएँ
एवं गुणधर्म
(दूसरा पुनरीक्षण)

**Hydrometry — Functional
Requirements and Characteristics
of Suspended-Sediment Samplers**
(*Second Revision*)

ICS 17.120.20

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Hydrometry Sectional Committee had been approved by the Water Resources Division Council.

Suspended-sediment samplers are used to collect a representative sample of the water-sediment mixture of rivers and streams. Ideally, the sampler should be able to collect samples that represent the mean concentration of suspended sediment or define the horizontal and vertical variation of suspended-sediment concentration so that the mean concentration can be determined. Samplers have gradually evolved from those that collect an instantaneous sample at one point in a stream or river to streamlined samplers that collect time and/or depth integrated samples. There are a number of different types of samplers available for collecting suspended sediment, including open containers, vertical and horizontal cylinders, bottle samplers, pumping samplers, single-stage samplers, point-integrating samplers and depth-integrating samplers. Some samplers have also been adapted to enable the collection of clean (uncontaminated) samples of trace metal and organic compounds that are commonly associated with suspended sediment in streams and rivers.

This standard was first published in 1966. The first revision was done in 2005. This revision is being done to align it with the latest version of ISO/TS 3716 : 2006 'Hydrometry — Functional requirements and characteristics of suspended-sediment samplers'. Main changes from the ISO/TS 3716 : 2006 decided by the Sectional Committee are as follows:

- a) In clause 5 an additional paragraph and Table 1 have been added to give further information on characteristics of suspended sediment samplers.
- b) A typical sketch of bottle type open container sampler has been added as Fig. 2 and figure on schematic diagram of a typical single-stage sediment sampler (now Fig. 6) has been modified.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HYDROMETRY — FUNCTIONAL REQUIREMENTS AND CHARACTERISTICS OF SUSPENDED-SEDIMENT SAMPLERS

(Second Revision)

1 SCOPE

This standard specifies the functional requirements and characteristics of the different types of suspended-sediment samplers.

NOTE — The units of measurement used in this standard are SI units.

2 REFERENCE

The following standard contains provision which, through reference in this text constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

<i>IS No.</i>	<i>Title</i>
1191 : 2003	Hydrometric determination — Vocabulary and symbols (<i>second revision</i>)

3 TERMS AND DEFINITIONS

For the purposes of this standard, the terms and definitions given in IS 1191 and the following shall apply.

3.1 Isokinetic

Intake velocity of the suspended-sediment sampler equals the ambient stream velocity.

4 REQUIREMENTS OF SAMPLERS

In order that the samples taken by a sampler are truly representative of the sediment concentration of a stream at a point of sampling, the ideal sampler should fulfil the following technical requirements:

- a) The sampler shall be streamlined to reduce drag and to minimize disturbances to normal sediment flow.
- b) The velocity of inflow in the mouth of the sampler, nozzle or sampling tube shall be isokinetic or as close as possible to the velocity of the current of water at the sampling

point, irrespective of what this velocity may be or irrespective of what the depth of submergence at this point may be. This aspect is most important if large sampling errors are to be avoided.

- c) The mouth/intake of the sampler shall always face into the current at the sampling point.
- d) The mouth/intake of the sampler shall be outside the zone of the disturbances of the flow set up by the body of the sampler and its operating gear, and the flow lines shall be disturbed as little as possible, especially near the mouth.
- e) Filling arrangements shall be smooth so that there is no sudden inrush of water-sediment mixture; the air escaping from the sampler shall not hinder the entry of the sample; this necessitates a separate port for air exhaust.
- f) The sampler shall be able to collect samples at the desired depth without the samples being disturbed or contaminated by the water-sediment mixture at other points while the sampler is being raised or lowered.
- g) It shall be possible to take a sample exactly when and where it is required, in particular when sampling close to the streambed.
- h) The sampler shall be portable, yet sufficiently heavy to minimize deflection of the supporting cable from the vertical due to current drag.
- j) The sampler shall be simple in design and robust in construction and shall require minimum care in maintenance and operation.
- k) The removable-type container within the sampler shall be easily removed, readily capped or sealed and easily transported to a laboratory without loss of contents. Alternatively, if the container forms part of the sampler, it shall be installed so as to secure complete drainage of the contents.
- m) The volume of the sample collected by the sampler shall be sufficient for determining the concentration and size distribution of the

sediment. The minimum sample size is generally 0.5 l.

- n) Depth-integrating samplers should be lowered or raised at a uniform and slow speed, a fraction of the current velocity, for example, between 2/5 and 1/15 (*see* Note).

NOTE — Depth integration (with uniform vertical motion – *see* Fig. 1):

$$A \cdot v \cdot t = V, \text{ assuming } v = v_n \quad \text{.....(1)}$$

$$i = k \cdot v, \text{ where } k = v_n/v \quad \text{.....(2)}$$

$$h = i \cdot t \quad \text{.....(3)}$$

where

- A = area of the mouth or tube,
- v = current velocity,
- v_n = velocity in the mouth/intake (nozzle) of the sampler,
- t = maximum duration of sampling,
- V = sample volume to be taken,
- i = uniform rate for sampler movement,
- k = transit rate ratio; and
- h = maximum vertical distance for sampling.

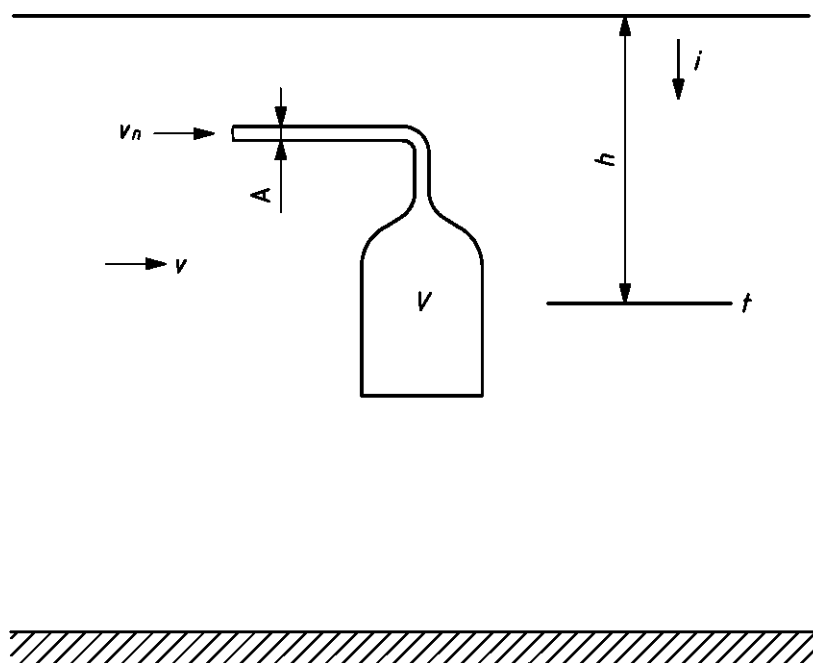
From Equations (1), (2) and (3):

$$h = k \frac{V}{A} \quad \text{.....(4)}$$

For example, with $A = 28.3 \text{ mm}^2$ ($\Phi 6 \text{ mm}$), $k = 1/10$ and $V = 0.5 \text{ l}$, the maximum depth of sampling is 1.76 m. If the flow depth is greater, sampling should be done with two or more sections in the vertical.

5 CHARACTERISTICS OF SUSPENDED-SEDIMENT SAMPLERS

Since the sampling conditions encountered in streams vary widely, a single sampler for all the conditions cannot be recommended. Factors such as availability, cost and specific requirements of the sampling also influence the choice of the sampler to a great extent. The different types of samplers include open containers, vertical and horizontal cylinders, bottle samplers, pumping samplers, single-stage samplers, point-integrating samplers and depth-integrating samplers. All of these types of samplers can collect a representative sample of the water-sediment mixture in a river or stream under the right conditions, but many of them cannot be used in rivers with swift currents and a non-uniform distribution of sediment concentration. For general use in rivers and streams, point-integrating and depth-integrating samplers are recommended. The use of trade, product or firm names in this document is for descriptive purposes only and



Key

- A = area of the mouth or tube,
- v = current velocity,
- v_n = velocity in the mouth/intake (nozzle) of the sampler,
- t = maximum duration of sampling,
- V = sample volume to be taken,
- i = uniform rate for sampler movement, and
- h = maximum vertical distance for sampling.

FIG. 1 SCHEMATIC DIAGRAM OF A SUSPENDED-SEDIMENT SAMPLER AND THE FACTORS AFFECTING SAMPLE VOLUME

does not imply endorsement.

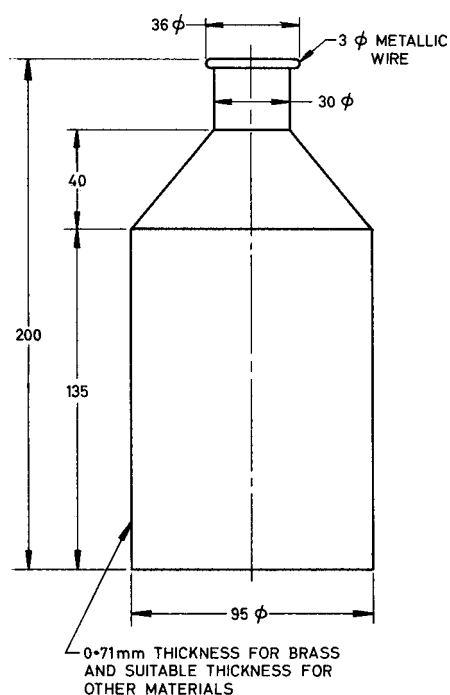
Characteristics of suspended sediment samplers like type of samplers, disturbance to the flow characteristics intermixing for water samplers, field handling and adaptability, the various field conditions are considered. The characteristics of different samplers to be taken into consideration while selecting the sampler are given in Table 1.

6 TYPES OF SAMPLERS

6.1 Open Containers

This type of sampler consists of an ordinary pail, can or open bottle. The sample is collected by holding the container under the surface of the water or by lowering it to the water surface with a rope or cable. The filled container can be sealed for transport and subsequent analysis or the sample can be transferred into another container that can be sealed.

The limitation of these samplers is that they can only collect a sample at the water surface. Representative samples will be collected only if the water-sediment mixture is thoroughly mixed and free of silt and sand. A typical sketch of bottle open container sampler is given in Fig. 2.



All dimensions are in millimetres.

FIG. 2 BOTTLE TYPE OPEN CONTAINER

6.2 Vertical and Horizontal Cylinders

These samplers are typically made of steel, brass or plastic (see Fig. 3). They are made in various diameters and lengths. The cylinder is lowered to the desired

sampling point with the valves at each end of the cylinder in the open position. The sample is collected by closing the valves and retrieving the cylinder. The valves are actuated by an electrical impulse or by sending a weight down the suspension cable to trip spring loaded valves. The sample is typically transferred to another container so the cylinder can be reused.

These samplers, particularly the vertical cylinders, offer considerable resistance to flow and are only stable at very low velocities. Vertical cylinders cannot sample close to the streambed. Horizontal samplers can sample near the streambed.

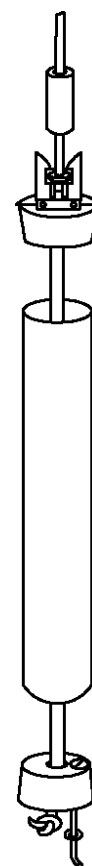


FIG. 3 KEMMERER SAMPLER

6.3 Bottle Samplers

There are many different variations of bottle samplers. They generally consist of a weighted container to hold a 0.5 l to 2 l sample bottle. The sampler is lowered to the desired depth by a rope or cable and then the cap is removed from the bottle to collect the sample. Some models have the capability of both opening and closing the bottle cap so the sample is sealed and no intermixing of the sample with the water-sediment mixture in the river occurs while the sampler is being retrieved.

These samplers offer considerable resistance to flow and are only stable at very low velocities. Samples

Table 1 Characteristics of Suspended-Sediment Load Samplers
(Clause 5)

Sampler No.	Type	Description	Disturbance to Flow Characteristics	Intermixing of Sample with Water	Sampling Action	Field Handling	Adaptability to Various Field Conditions
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A1	Can or pail	Ordinary can or pail	Considerable	Considerable	Instantaneous	Not necessary to transfer the contents	Offers considerable resistance to current. Only surface samples are taken
A2	Vertical pipe	With a vertical cylinder or pipe forming the container. When the sampler is lowered to the desired depth, water sediment mixture flows upward through the container. Valves at either end close and trap the sample	Considerable	None	Instantaneous. Samples are not weighted according to velocity distribution	Necessary to transfer into another container	Offers considerable resistance to current. Not satisfactory when close to stream bed. Effective in still water or at very low velocities.
A3	Instantaneous vertical	A vertical sampler with arrangement to open the sampler for the instantaneous (rapid) intake of samples at the desired time and depth	Effect not evaluated	None	Instantaneous	Necessary to transfer into another container	Not satisfactorily streamlined or adapted for use near stream bed. Effective in still water or at very low velocities
A4	Vertical	A vertical sampler with opening arrangement for slow intake of samples at the desired time and depth	Effect not evaluated	None	Slow filling, no initial inrush	Necessary to transfer into another container	Allows sampling very close to stream bed. Effective in still water or at very low velocities
A5	Bottle	Consisting of a standard container held in a case with a device for lowering and opening at the sampling point. The mouth is kept open for the minimum time required to fill the bottle	Considerable	Considerable, if not opened and closed at the sampling point	Bubbling or slow filling after initial inrush	Container with sample removable	Not capable of sampling close to stream bed. Has high efficiency in trapping fine grade sediment and the efficiency is less with the increase in grade
A6	Bottle (modified)	Consisting of a litre capacity container fitted in a case with a device for lowering or raising and opening at the sampling point. Provided also with separate water intake and air exhaust device for equalizing pressure inside and outside the container	Considerable	Considerable, if not opened and closed at the sampling point	Slow filling, no initial inrush present	Container with sample detachable	Not capable of sampling close to stream bed
A7	Single-stage suspended-sediment sampler (automatic)	Used for automatic collection of samples from flashy, intermittent streams at remote sites. The sampling unit consists of a bottle with an intake and an exhaust tube, each tube bent to an appropriate shape. Several sampling units are mounted one above another on a vertical support. As the water surface rises in the stream, it also rises in the intake tube of the sampler. When water reaches the crown of the intake, flow starts and the bottle fills. The sampling ceases when the water level in the bottle reaches the inner end of the air exhaust which is kept at a lower level than the inner end of the intake.	Inconsiderable	Inconsiderable	Slow filling, no initial inrush	Container with sample removable	Not capable of sampling close to stream bed. Samples are usually obtained near the edge of the stream. No samples are taken during the falling stages. There are two types of intake, namely, vertical and horizontal. Vertical type is used for sediments finer than 62µm and the horizontal intake is used for sediments coarser than 62µm

B1	Instantaneous horizontal	With a horizontal cylinder equipped with end valves which can be closed suddenly to trap instantaneous samples at any desired time and depth	Inconsiderable	Inconsiderable	Instantaneous	Necessary to transfer into another container	Allows sampling very close to stream bed. Adaptable to any stream or depth
B2	Point integrating	A streamlined body with tail vanes, containing a sampling bottle designed to fill continuously at a given point over an interval of time. Therefore, it is provided with an opening and closing mechanism and also with a pressure equalizer to minimize the initial inrush of water. Many of these samplers are capable of being used as depth integrating samplers also	Inconsiderable	Inconsiderable	Smooth-filling, minimum initial inrush	Container with sample removable	
B3	Vacuum (suction developed by pump)	The sediment mixture is sucked in through a pipe or hose, the intake of which is placed at the desired sampling point. By regulating the intake velocity an undisturbed sample can be obtained.	Inconsiderable	None	Time- integrated	Container with sample removable	Present design not transportable. Somewhat limited in use owing to resistance to current. Heavy sediment loss in pipeline may limit the use. As there is a difference between the average concentration in the stream and that at the intake, a correction is required which varies with stage and sediment.
B4	Intermittent pumping (automatic)	Designed for use at sites where personnel are not available to take samples manually, for example, ephemeral and flashy streams or streams in isolated locations. Samples are taken from an intake in the stream by means of a pump. Prior to sampling the intake system is flushed. The sampling frequency is controlled on the basis of stage at the installation so that samples may be collected at a certain interval during low water and at more frequent intervals during higher stages. Some models also permit sampling on a time as well as a stage basis.	Inconsiderable	None	Smooth filling	Container with sample removable	The sampler is transportable. More efficient in trapping fine sediments. As there is a difference between the average concentration in the stream and that at the intake, a correction is required which varies with stage and sediment.
B5	Depth-integrating	A streamlined body with tail vanes, containing a sampling bottle and designed to fill continuously during lowering from surface to bed (as well as on the return trip from bed to surface). These do not have an opening and closing system as in the point-integrating type. The samplers designed to fill during lowering only are provided with a foot trigger which closes both inlet and exhaust upon contact with the bed.	Considerable	Inconsiderable	Smooth-filling. Although the sampled filament will enter the intake nozzle at an angle, provisions exist for making inlet velocity essentially equal to the local velocity of the stream	Container with sample removable	Capable of sampling close to the stream bed

cannot typically be collected close to the streambed. The potential for intermixing of the sample and water sediment mixture in the river is high for those samplers that cannot be sealed at the sampling point.

6.4 Pumping Samplers

6.4.1 General

There are two types of pumping samplers used for collecting suspended-sediment samples: those with a fixed orifice that are operated in automatic mode and those with a moveable orifice that are deployed from a boat, walkway or bridge.

6.4.2 Fixed-Orifice Samplers

Fixed-orifice samplers (*see* Fig. 4) typically are used at sites where personnel are not available to take samples manually, such as ephemeral and flash streams or streams in isolated locations. The orifice is typically located at or near the stream bank. The samplers are powered with line power or batteries, and samples are pumped from the stream to sample containers. The first phase of sampling is back flushing to prime the pump and flush accumulated sediment from the orifice line. Sampling frequency is controlled on the basis of both time and stage so that samples can be collected at one interval during low flow and more frequently during high flow.

The fixed-orifice samplers are an effective method of collecting samples when personnel are not available for collecting manual samples. However, the samples only represent the suspended-sediment concentration at one point in one vertical of the stream and a correction factor is required to determine the mean suspended sediment concentration. Samples also are subject to evaporation until they are sealed and removed for analysis.

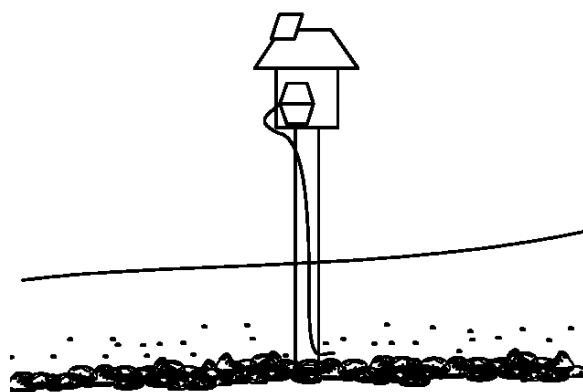


FIG. 4 DIAGRAM OF A FIXED-ORIFICE PUMPING SAMPLER

6.4.3 Moveable Orifice Samplers

These are usually used to collect large volume samples for analyses of suspended sediment and other

constituents. A pump on a boat or other platform above the water surface is used to create a vacuum to raise the water-sediment mixture to a sample container on the boat or work platform. An orifice line is lowered to the desired sampling depth to obtain the sample. The orifice also can be lowered during sampling to collect a depth-integrated sample. A submersible pump can also be lowered on a cable, and then the sample is pumped to containers on the platform or vessel (*see* Fig. 5). Some units are equipped with a velocity sensor to automatically adjust the pump speed to collect an isokinetic sample. Alternatively, it is possible to measure the velocity at the point of sampling by current meter and then manually adjust the rate of pumping to match the velocity of sampling with the stream velocity.

These samplers are good for collecting large volume samples, but the combination of the orifice line and the weight to hold the orifice in place offer much resistance to flow. The vacuum pump versions of these samplers are limited to collecting samples to a depth of about 7 m because of the efficiency of vacuum pumps.

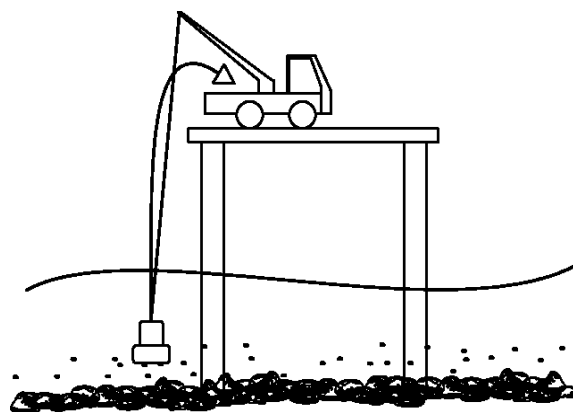
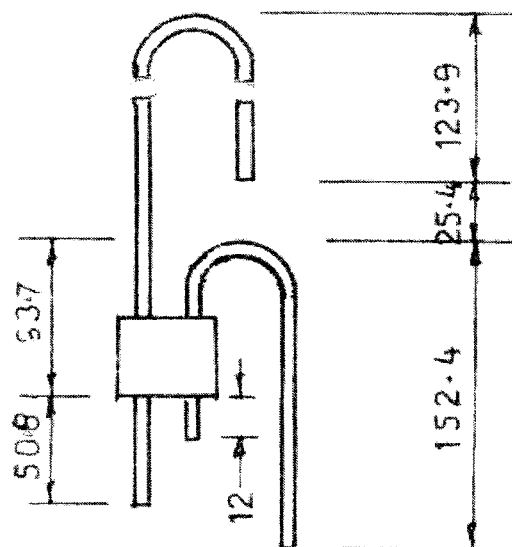


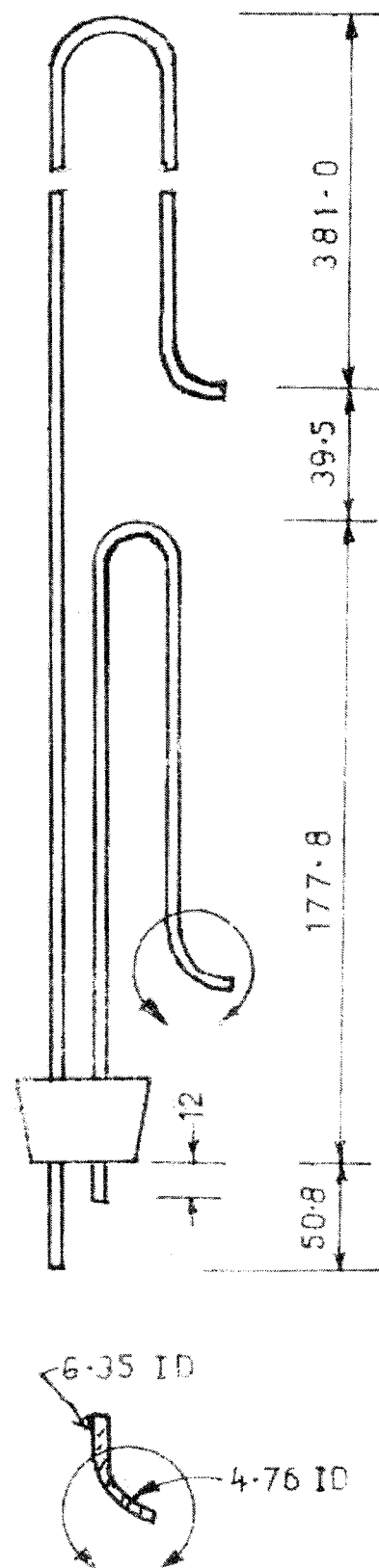
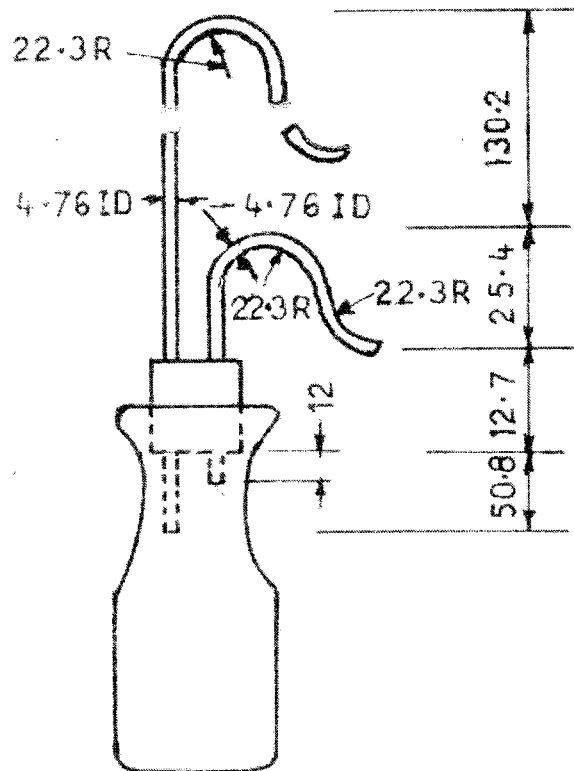
FIG. 5 DIAGRAM OF THE SUBMERSIBLE-PUMP VERSION OF A MOVEABLE-ORIFICE PUMPING SAMPLER

6.5 Single-Stage Samplers

Single-stage samplers are an inexpensive and effective means of collecting sediment samples on intermittent and flash streams and at remote locations. The sampling unit consists of a bottle with an intake tube and an exhaust tube (*see* Fig. 6). The orifice and inverts of the tubes are positioned to collect a representative sample a few centimetre below the water surface; recirculation within the bottle is prevented by the air lock that occurs between the inverts of the intake and exhaust tubes. Several units may be mounted at different positions on a vertical support to collect samples as the water level rises during a runoff event. After the peak passes, the bottles are removed and sealed for transport and subsequent analysis.



VERTICAL INTAKE



All dimensions are in millimetres.

FIG. 6 SCHEMATIC DIAGRAM OF A TYPICAL SINGLE-STAGE SEDIMENT SAMPLER

These samplers can only collect near surface samples during rising stages. Samplers are generally located near the stream bank for ease of servicing and to avoid heavy debris. Sample concentrations will only be representative of the mean concentration of the sediment in the stream if the water-sediment mixture is very well mixed with most particles finer than 0.062 mm.

6.6 Point-Integrating Samplers

There are a number of different models and sizes of point-integrating sediment samplers. They generally consist of a bronze or aluminium, streamlined body with tail vanes for stability in high currents (*see* Fig. 7). They are raised and lowered in the river with a reel and cable assembly. Water enters through a nozzle at the nose of the sampler body, and the sample is collected in a bottle or other container within the sampler. Some samplers have interchangeable nozzles that are used depending on the flow velocity and river depth. The containers, which are usually 0.5 litre or 1 litre glass or plastic bottles, are removed from the sampler and sealed for shipment and analysis. The sampler includes an opening and closing mechanism that allows samples to be collected at any depth after equalizing the pressure inside the sampler with the pressure at the depth of sampling to ensure isokinetic sampling.

These samplers also are used for collecting depth-integrated samples.

- For depths up to 5 m, the sampler can be lowered and raised with the valve open.
- For depths greater than 5 m, the sampler can be lowered and raised at different increments of depth and samples can be combined to obtain a mean suspended-sediment concentration for the vertical.

For example, with a depth of 10 m, a point sampler can be used to collect 2 samples. Lowering and raising the sampler with the valve open to a depth of 5 m would collect the first sample; lowering the sampler to 5 m with the valve closed and then lowering and raising it between 5 m and 10 m with the valve open would collect the second sample.

6.7 Depth-Integrating Samplers

Depth-integrating samplers are very similar to point-integrating samplers. They have streamlined bodies with a nozzle at the nose and tail vanes for stability. They do not have a valve for opening and closing the nozzle. These samplers include those that are attached to a wading rod, those that are raised and lowered by hand with a rope, and those that are raised and lowered by a reel and cable assembly. There are two types of depth-integrating samplers: those that contain rigid containers and those that contain a plastic or fluoropolymer bag. The samplers that contain rigid containers are limited to a sampling depth of 5 m in order to maintain isokinetic sampling and avoid overfilling of the containers.

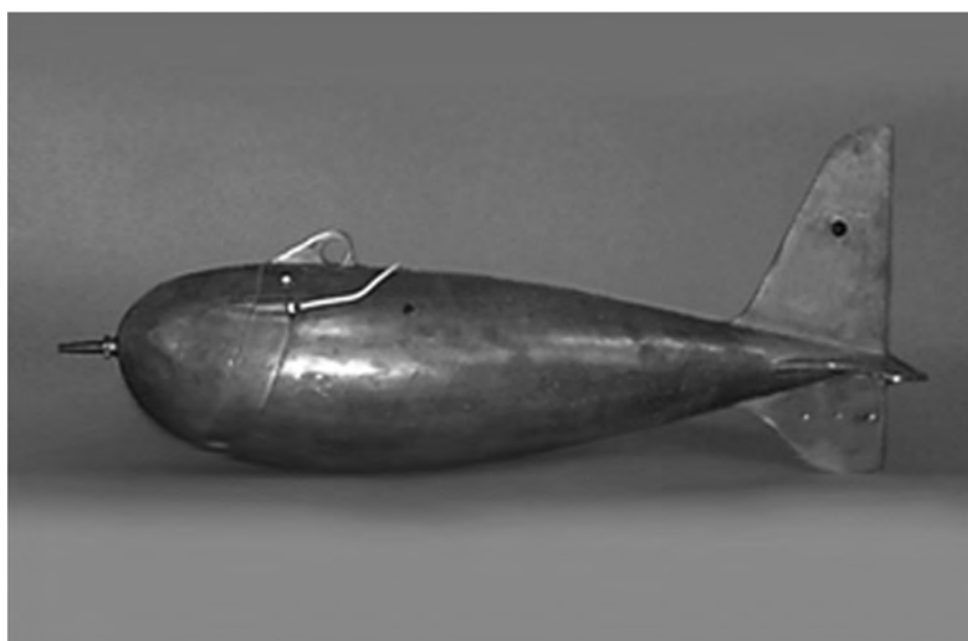


FIG. 7 US P-61-A1 SUSPENDED-SEDIMENT SAMPLER DEVELOPED BY THE FEDERAL INTERAGENCY SEDIMENTATION PROJECT IN THE UNITED STATES

A newer type of depth-integrating sampler has a plastic or fluoropolymer bag instead of a bottle for the samples. All the air is evacuated from the bag before the sampler is lowered in the river so the depth of sampling is not restricted by the compression of air in the container. The US D-96 (*see* Fig. 8) sampler developed by the Federal Interagency Sedimentation Project in the United States can be used for collecting depth-integrated samples to a depth of 15 m to 30 m depending on the size of nozzle used. When the sampler is retrieved, either the sample is transferred from the bag to another container or the bag is sealed and placed in another container for shipment to the laboratory.

The depth-integrating and point-integrating samplers are the only samplers that will collect a representative sample

of the water-sediment mixture in deep, swift rivers.

6.8 Clean Samplers

Variations of depth-integrating sediment samplers are special samplers for collecting water-sediment mixtures for chemical analyses. These samplers are very similar to the suspended-sediment samplers, except they are equipped with fluoropolymer and plastic components so the samples will not be in contact with any metal. The DH-95 sampler (*see* Fig. 9) uses 1 litre fluoropolymer or plastic bottles with nozzles that are integral with the bottle caps.

7 MODELS OF SAMPLERS

Table 2 is a summary of the most widely used suspended-sediment samplers today.

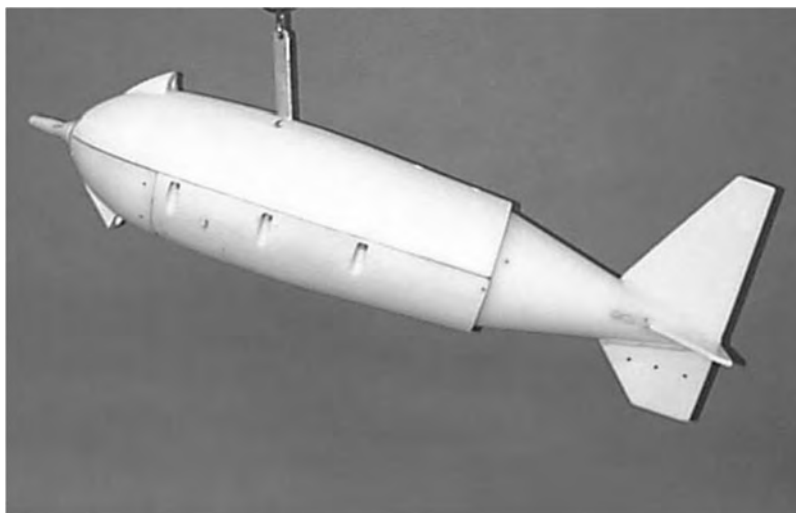


FIG. 8 US D-96 BAG SAMPLER DEVELOPED BY THE FEDERAL INTERAGENCY SEDIMENTATION PROJECT

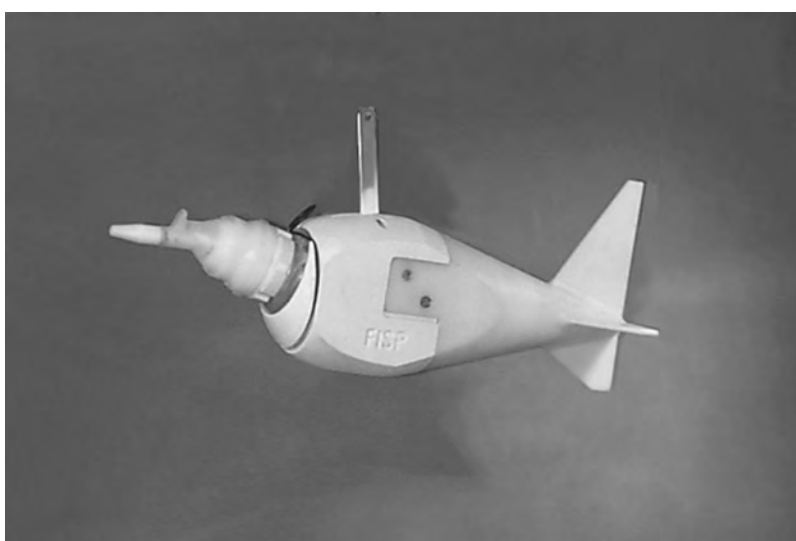


FIG. 9 US DH-95 SAMPLER DEVELOPED BY THE FEDERAL INTERAGENCY SEDIMENTATION PROJECT

Table 2 Models of Samplers in Use in Different Countries
(Clause 7)

Sampler Type	Model Name ¹⁾	Countries of Use	Mass in kg	Method of Suspension	Sample Size in litres
Open container		Japan, India, USA	Variable	Hand or rope	Variable
Vertical or horizontal cylinder	Kemmerer	USA		Rope or cable	
	Niskin	Netherlands	2.5	Rope	1.7
	Vertical pipe	India, UK		Rope	1
Bottle	Punjab	India		Rope	
	US WBH-96	USA		Rope or cable	1
Pumping	ISCO 1680	Germany, Japan, Netherlands, Switzerland, USA		Streambank shelter	0.5
	Lift pump	Germany, Japan, Netherlands, Switzerland, USA		Cable	Many litres
	Manning PST		11.1	Streambank shelter	1
	Manning VST	USA	11.1	Streambank shelter	1
	Suspended water pump	Germany, Japan, Netherlands, Switzerland		Cable	Many litres
Single-stage	US U-59	USA	1		0.5
Point-integrating	ASP 2000	Germany, Netherlands, Switzerland			0.5
	ASPEG	Germany, Netherlands, Switzerland			
	AYX Pressure Equalizing Sampler	China	100, 150 and 300	Cable	2.5
	ANX3 Bag Sampler	China	100, 200, 300 and 400	Cable	3
	Delft Bottle	Netherlands		Cable	
	P 50	India		Cable	0.5
	Turbidisonde	France	92	Cable	
	US P-61-A1	USA	48.5	Cable	0.5 or 1
	US P-63	USA	91.6	Cable	0.5 or 1
	US P-72	USA	18.6	Cable	0.5 or 1
Depth-integrating	APX Bottle Sampler	China	100 and 150	Cable	2.5
	Collapsible Bag	Netherlands		Cable	5 to 10
	D 49	India		Cable	0.5
	Horizontal Bottle	Russia		Cable	
	LS Bag Sampler	China	75, 150 and 250	Cable	3 or 5
	PWRI	Japan		Cable	
	SGS M266 D/10	Germany, Netherlands, Switzerland	1.3	Rod	1
	State Hydrological Institute	Russia		Cable	
	TOHOKU	Japan		Cable	
	US DH-48	USA	1.6	Rod	0.5
	US DH-59	USA	10	Rope	0.5
	US DH-76	USA	11.3	Rope	1
	US DH-81	USA	1.0	Hand	1
	US DH-95	USA	13.1	Rope	1
	US D-74	USA	28.1	Cable	0.5 or 1
	US D-77	USA	34	Cable	2.7
	US D-95	USA	29	Cable	1
	US D-96	USA	61	Cable	3
	1970 SGLN	Germany, Netherlands, Switzerland	8	Cable	1

¹⁾ The majority of the models listed are examples of suitable products available commercially. This information is given for the convenience of users of this standard and does not constitute an endorsement by ISO/BIS of these products.

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